Remarks

I. Status of Claims

Claims 1-10 and 12-18 are pending.

The claim following claim 9 has been renumbered as claim 10 to correct a typographical error in the Preliminary Amendment filed July 29, 2003.

II. Claim rejections under 35 U.S.C. § 102

The Examiner has rejected claims 1-10 and 12-18 under 35 U.S.C. § 102(a) over the cited document entitled "JPEG 2000 Image Coding System" (referred to herein as the "JPEG 2000 document").

As established by the attached Declaration Under 37 CFR § 1.131, however, Applicant had reduced to practice the subject matter recited in claims 1-10 and 12-18 in this country prior to the publication date (i.e., March 16, 2000) of the JPEG 2000 document. Accordingly, the JPEG 2000 document is not prior art.

For this reason, the Examiner's rejection of claims 1-10 and 12-18 under 35 U.S.C. § 102(a) over the JPEG 2000 document should be withdrawn.

III. Claim rejections under 35 U.S.C. § 103

The Examiner has rejected claims 1-10 and 12-18 under 35 U.S.C. § 103(a) over the documents WG1N1020R and WG1N1201 (referred to herein as the "disclosed JPEG prior art"), which are described in the present application, in view of Schwartz (U.S. 5,815,097) and Budge (U.S. Patent Application No. 2002/0080408).

A. The Examiner's § 103(a) rejection should be withdrawn because Budge is not prior art

As established by the attached Declaration Under 37 CFR § 1.131, Applicant had reduced to practice the subject matter recited in claims 1-10 and 12-18 in this country prior to

the effective filing date (i.e., December 17, 1999) of Budge. Accordingly, Budge is not prior art.

For at least this reason, the Examiner's rejection of claims 1-10 and 12-18 under 35 U.S.C. § 103(a) over the disclosed JPEG prior art in view of Schwartz and Budge should be withdrawn.

B. The Examiner's § 103(a) rejection should be withdrawn for the following additional reasons

1. Independent claims 1 and 6

Independent claims 1 and 6 each requires transform coefficient data from at least one bit-plane not subjected to arithmetic coding to be included in an encoded bit-stream.

The Examiner has acknowledged that the disclosed JPEG prior art "does not teach or suggest the feature that 'coefficient data from at least one bit-plane is included in the encoded bit-stream without arithmetic coding.'"

In his rejection of claims 1 and 6, the Examiner has stated that:

> It is desirable for reducing the entropy coding operations and allowing hardware to operate at faster speeds. It would have been obvious to one of ordinary skill in the art, at the time of the invention, to apply the teachings of Schwartz and Budge to bypass arithmetic coding of the K least significant bit-planes of the data, which are randomly distributed, taught in the admitted prior art, because the overall combination provides an advantage of reducing the entropy coding operations.

In reaching this conclusion, the Examiner has relied on the following disclosure of Schwartz:

> The passage in column 9, lines 23-43 teaches: "For predictive coding data, some of the data can be assumed to be 50% random data and simply copied to/from the compressed data without needed entropy coding, thereby reducing the entropy coding operations and allowing hardware to operate at faster speeds." The passages in column 11, lines 37-53 and column 13, lines 12-32 teaches that data are passed to manager 1207 without arithmetic coding.

The Examiner has relied on Budge for the following proposition: "Budge teaches that the k least significant bits of a sequence of N-bit data are randomly distributed."

These teachings of Schwartz and Budget, however, relate to predictive coding in the image domain. These disclosures do not teach or suggest anything about arithmetic coding of bit-planes of transform coefficient data, which is performed in the transform domain. In his rejection of claims 1 and 6, the Examiner implicitly has assumed that one skilled in the art at the time the invention was made would have been motivated to apply Schwartz' and Budge's teachings, which relate to the statistics of the least significant bits of predictive pixel errors in the image domain, to the image coding approach that is described in the disclosed JPEG prior art, an approach which is based on bitplane context models in the transform domain. None of the cited references, however, supports this implicit assumption. Indeed, none of the cited references even hints that the statistics of the least significant bits of predictive pixel errors in the image domain are similar to the statistics of the high frequency transform coefficients in the bitplane context model used in the disclosed JPEG prior art.

Therefore, none of the cited references provides any motivation that would have led one skilled in the art to modify the approach described in the disclosed JPEG prior art in the manner proposed by the Examiner. To the contrary, Schwartz expressly teaches away from such a modification. In particular, Schwartz expressly teaches that (col. 9, lines 29-30):

> ... in a bit-plane context model, every bit is entropy coded. N-bit data requires N coding operations.

That is, Schwartz expressly teaches that, in bit-plane context-model-based image compression approaches of the type described in the disclosed JPEG prior art, "every bit is entropy coded." Similarly, every bit is entropy encoded in the disclosed JPEG prior art, and Budge does not contradict Schwartz's teaching that in bit-plane coding "every bit is entropy coded." Accordingly, based on the combined teachings of the disclosed JPEG prior art, Schwartz, and Budge, one of ordinary skill in the art at the time of the invention would have entropy encoded the data from every bit-plane before assembling the final bit stream in a bit-plane context model based image compression implementation.

Without any support for his modification of image compression approach described in the disclosed JPEG prior art, it appears the Examiner has reached his conclusion of obviousness based upon impermissible hindsight gleaned from Applicants' disclosure.

In addition, the Examiner has not explained the basis on which one skilled in the art at the time the invention was made would have had a reasonable expectation that the Examiner's proposed modification of the image compression approach described in the

disclosed JPEG prior art would have been successful (see MPEP § 706.02(j)). In particular, none of the cited references provides any guidance as to how to concatenate the arithmetically coded data with the uncoded data in a way that could be decoded successfully.

In summary, none of the cited references, taken alone or in any permissible combination, teaches or suggests the bit-plane coding based method and system recited in claims 1 and 6, respectively, in which transform coefficient data from at least one bit-plane is included in an encoded bit-stream without arithmetic coding. For at least this additional reason, the Examiner's rejection of independent claims 1 and 6 under 35 U.S.C. § 103(a) should be withdrawn.

2. Dependent claims 2-10 and 12

Claims 2-5 and 12 depend from independent claim 1 and claims 7-10 depend from independent claim 6. Therefore, these claims are patentable for at least the same reasons explained above.

With regard to the subject matter of dependent claims 4 and 9, the Examiner has asserted that the combination of Schwartz and Budge teaches that coefficient data from bit-planes $p<p_0-K$ are written directly into the encoded bit-stream without arithmetic coding, where $K=3$. In support of this assertion, the Examiner has indicated that:

> It is well known that a pixel usually has 8 bits. Schwartz teaches in column 11, lines 21-27 that three or four entropy coding operations are performed on the amplitude data.

The number of bits in a bit-plane, however, is determined by a number of factors, including the number bits per pixel in the original image and any transform or prediction that may be applied to the data. If no transform is applied then the number of bit-planes is simply the number of bits per pixel in the image. If a transform is applied, the dynamic range of some of the transform coefficients is usually larger than that of the pixels so a greater number of bit-planes is required. The precise number bit-planes depends on, for example, the transform, whether it is a lossy or lossless transform, and the particular band of the transform in the case of wavelets.

In any event, Schwartz's teaching that three or four entropy coding operations are needed to code prediction error magnitudes in the image domain with a four bit number does

not teach or suggest anything about writing transform coefficient data from certain bit-planes directly into an encoded bit stream without arithmetic coding, much less anything about writing coefficient data from bit-planes with significance levels below the three most significant bit-planes directly into the encoded bit stream without arithmetic coding.

Thus, for this additional reason, the Examiner's rejection of dependent claims 4 and 9 under 35 U.S.C. § 103(a) should be withdrawn.

Claim 12 recites that "arithmetically coded bit-plane data is interleaved with the bit-plane coefficient data included in the bit-stream without arithmetic coding."

In his rejection of claim 12, the Examiner has stated that:

> ... because (1) each code-block taught in the admitted prior art is coded and transmitted one by one and (2) the combination teaches coding each code-block with and without arithmetic coding, the combination also teaches the feature that arithmetically coded bit-plane data is interleaved with the bit plane coefficient data included in the bit-stream without arithmetic coding.

In this rejection, however, the Examiner has not explained the basis on which one skilled in the art at the time the invention was made would have had a reasonable expectation that the Examiner's proposed modification of the image compression approach described in the disclosed JPEG prior art would have been successful (see MPEP § 706.02(j)). In particular, in addition to failing to teach or suggest the features of independent claims 1 and 6 discussed above, none of the cited references provides any guidance as to how to concatenate the arithmetically coded data with the uncoded data in a way that could be decoded successfully.

For this additional reason, the Examiner's rejection of dependent claim 12 under 35 U.S.C. § 103(a) should be withdrawn.

3. Independent claim 13

Independent claim 13 recites:

> 13. A method for compressing image data, comprising the steps of:
>
> decomposing the image data into code-blocks of coefficients using a transform, each code-block comprising a

plurality of bit-planes from a most significant bit-plane to a least significant bit-plane;

processing bit-planes of coefficient data in the code blocks in multiple coding passes to generate raw bit-plane data;

arithmetically coding a portion of raw bit-plane data to generate arithmetically coded data; and

writing the arithmetically coded data and the raw bit-plane data not arithmetically coded directly into a bit-stream.

As explained above in connection with independent claims 1 and 6, the combined teachings of the disclosed JPEG prior art, Schwartz, and Budge, would have led one of ordinary skill in the art at the time of the invention to entropy encode the data from every bit-plane before assembling the final bit stream in a bit-plane context model based image compression implementation.

In addition, in his rejection of independent claim 13, the Examiner has not explained the basis on which one skilled in the art at the time the invention was made would have had a reasonable expectation that the Examiner's proposed modification of the image compression approach described in the disclosed JPEG prior art would have been successful (see MPEP § 706.02(j)). In particular, none of the cited references provides any guidance as to how to concatenate the arithmetically coded data with the uncoded data in a way that could be decoded successfully.

For at least these additional reasons, the Examiner's rejection of independent 13 under 35 U.S.C. § 103(a) should be withdrawn.

4. Dependent claims 14-18

Claims 14-18 incorporate the features of independent claim 13 and therefore are patentable over the disclosed JPEG prior art, Schwartz, and Budge for at least the same reasons explained above in connection with claim 13.

IV. Double patenting rejections

A. Claims 1-5 and 12-18

The Examiner has rejected claims 1-5 and 12-18 under the doctrine of obviousness-type double patenting over claims 1-8 of U.S. Patent No. 6,658,159.

The Terminal Disclaimer being filed herewith should overcome this obviousness-type double patenting rejection.

B. Claims 6-10

The Examiner has rejected claims 6-10 under the doctrine of obviousness-type double patenting over claims 1-4 of U.S. Patent No. 6,658,159 in view of the JPEG 2000 document.

As explained above in connection with the §102(a) rejection of independent claims 1 and 6, the JPEG 2000 document is not prior art with respect to the present application. For at least this reason, the Examiner's double patenting rejection of claims 6-10 should be withdrawn.

In addition, the Examiner's double patenting rejection of claims 6-10 also should be withdrawn in light of the Terminal Disclaimer being filed herewith.

V. Conclusion

For the reasons explained above, all of the pending claims are now in condition for allowance and should be allowed.

Charge any excess fees or apply any credits to Deposit Account No. 08-2025.

Respectfully submitted,

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